

Conditions of Combustion

Chapter 1



Lessons in this chapter

1-1

Air and Burning Objects

1-2

The Role of Oxygen

1-3

Air After Combustion



By the end of this chapter, you will be able to:

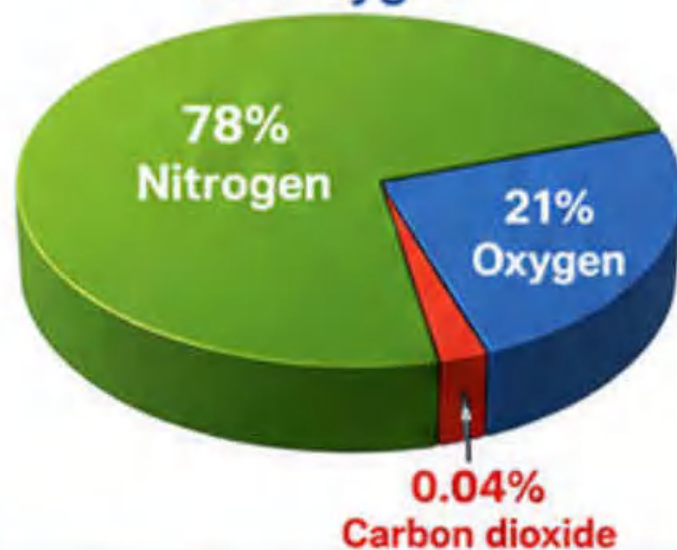
- ✓ Explain that air is necessary for combustion to occur and continue.
- ✓ Identify oxygen as the gas in air that supports burning.
- ✓ Recognize that atmospheric air is a mixture of gases, mainly nitrogen, oxygen, and a very small amount of carbon dioxide.
- ✓ Explain that after combustion, the percentage of oxygen decreases and carbon dioxide is produced.
- ✓ Use limewater to detect the presence of carbon dioxide.
- ✓ Describe how gas-detection tubes and gas-monitoring devices help detect gases.
- ✓ Connect combustion with real-world topics: the ancient use of fire, the greenhouse effect, and renewable energy such as Benban Solar Power Station.


 O_2
 N_2 O_2 CO_2
 CO_2


1-1 Air and Burning Objects



1-2 The Role of Oxygen



1-3 Air After Combustion



Air and Burning Objects

Air is necessary for combustion.



Check Your Understanding

- 1 Is air necessary for combustion to happen?
Yes ☐ No ☐
- 2 Does a burning candle keep burning when it is covered by a jar?
Yes ☐ No ☐



Why Air is Important

- ✓ Air is **necessary** for combustion to happen and to continue.
- ✓ If **air stops reaching** the burning material, combustion stops.
- ✓ If the available **air is used up**, combustion stops.



Air Renewal and Continued Combustion

Fresh air must keep reaching the flame.

When **air is renewed**, the flame can continue to burn.



Example: A Candle Covered by a Jar

A burning candle covered with an inverted jar (closed on the bottom) **goes out after a short time**.

This happens because the **air inside the jar is used up**.



After a short time:
The flame goes out.



With air still reaching it: The candle keeps burning.



Remember

For a flame to keep burning, fresh air must always be available.





Activity: The Importance of Air in Combustion

A practical investigation.



Aim

To show the importance of air in combustion.



Tools



Wooden board



Clay



Candle



Candle holder



Metal cover



Lighter or match



Jar with no bottom



Waste box / disposal container



Steps

1

Fix the candle on clay on the wooden board and light it.



2

Cover the jar opening as shown.



3

Observe the candle and note that it goes out after a short time.



4

Remove part of the clay from below the jar to allow a little air to enter and relight the candle.



5

Open the metal cover on top and observe again.



Observations

1

When air is cut off, the flame goes out.



2

When a small amount of air enters, the flame continues weakly.



3

When more air enters from above, the flame becomes stronger.



Explanation

1

Without air, the candle does not get what it needs to burn, so it goes out.

2

A little air enters from the bottom, so the candle continues burning, but weakly.

3

More air enters from the top, so more air reaches the candle and the flame becomes stronger.



What we learn



Air is necessary for combustion. The more air reaches the flame, the stronger the burning.



The Role of Oxygen

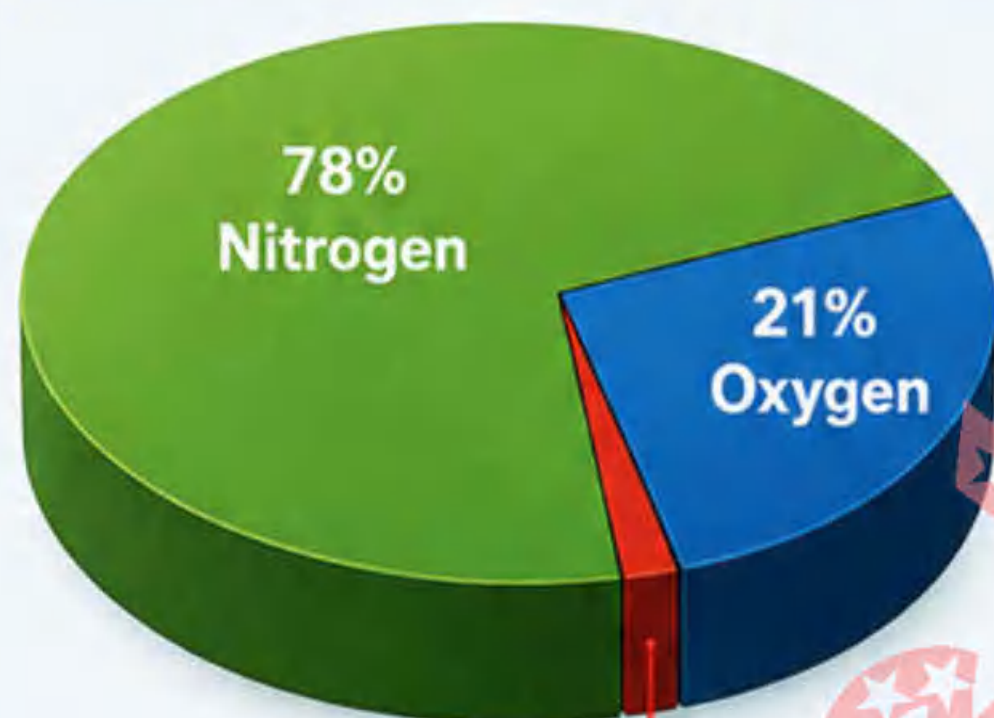
Which gas supports combustion?

- ☐ Atmospheric air is a mixture of several gases.
- ☐ Oxygen is the largest component of air.



CONCEPT

Atmospheric air is a mixture of different gases present in unequal proportions.



About 0.04%
Carbon dioxide



The percentages of other gases are very small.

Composition of Air

Air is made up of three main gases:

- **Nitrogen**
Makes up about (78%) of the volume of air.
- **Oxygen**
Makes up about (21%) of the volume of air.
- **Carbon dioxide**
Makes up about (0.04%) of the volume of air.



Other gases are present in the air in very small percentages.



The Gas that Supports Combustion



Oxygen helps combustion.



Nitrogen and **carbon dioxide** do not support combustion.



The Importance of Oxygen

1

Oxygen is necessary for combustion.

2

Oxygen is necessary for respiration in living organisms.



DEFINITION

Combustion (burning) is the process in which a substance combines with oxygen.





Activity: Discovering Which Gas Supports Combustion



Tools and Materials



3 candles
(identical)



1 candle
holder



3 glass jars



1 basin
of water



3 balloons

NITROGEN

OXYGEN

CARBON DIOXIDE

Labels for
gases



3 glass covers or lids



1 small hand pump
(for gases)



Nitrogen

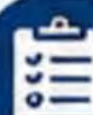


Oxygen



Carbon
dioxide

Prepared
gases



Steps

- 1 Place equal amounts of the three gases in three jars.
- 2 Place a burning candle in each jar.



Observation



Jar 1
Nitrogen



Jar 2
Oxygen



Jar 3
Carbon Dioxide



Explanation / Conclusion

Oxygen is necessary for combustion to happen and continue.
Nitrogen and carbon dioxide do not support combustion.



How can gases be collected?

A gas that does not dissolve or react with water can be collected by filling an inverted jar with water and allowing the gas to enter. When the jar is about **70%** full of gas, cover it with a glass plate or lid.



- 1 Fill an inverted jar completely with water under the water.



- 2 Allow the gas to enter and push the water out of the jar.



- 3 When the jar is about 70% full of gas, stop the gas flow.



- 4 Cover the mouth of the jar with a glass plate or lid.

Air After Combustion

How the air changes after burning



Check What You Know



Nitrogen gas is produced when materials burn.



Combustion causes the percentage of oxygen to decrease.



What Happens to Air During Combustion?

- Combustion changes the composition of air.
- During burning, **oxygen** in the surrounding air is consumed, so the percentage of oxygen **decreases**.
- Burning also produces **carbon dioxide**, so the percentage of carbon dioxide **increases**.

Oxygen enters



Carbon dioxide leaves



Detecting Carbon Dioxide

- Limewater is used to detect carbon dioxide.
- When carbon dioxide passes through limewater, the limewater becomes **cloudy** or milky white.



Definition

Limewater is a clear, colorless liquid that becomes cloudy when it reacts with carbon dioxide.

Limewater Reaction



Clear limewater (before)



Cloudy limewater (after carbon dioxide passes through)

Activity: Testing the Change in Air Using Limewater



AIM

To test how air changes during combustion using limewater.



TOOLS



Candle



Bottomless Jar



Metal Cover



Gas Lighter or Match



Two Jars



Limewater



STEPS

- 1 Put equal amounts of clear limewater into two jars.
- 2 Place a burning candle in one jar and cover it with the metal cover.
- 3 After the candle goes out, remove the candle from the jar and shake both jars well.



OBSERVATION

- In the first jar (with the candle), the limewater turns milky white.
- In the second jar (without the candle), the limewater remains unchanged.



EXPLANATION

When the candle burns, carbon dioxide gas (CO_2) is produced. This gas reacts with limewater and forms a new white substance (calcium carbonate). This makes the limewater cloudy.



CONCLUSION

Combustion produces carbon dioxide.



SAFETY WARNING



Wear safety goggles so limewater does not reach your eyes.

Tools for Detecting Gases

1 Colored Tubes for Detecting Gases

Glass tubes that contain colored chemical substances which react with gases.



Purpose: to detect gases and determine their concentration.

Colored detection tube

Hand sampling pump



Steps for Use

1 Break both sealed ends of the tube.



2 Connect one end of the tube to the sampling pump.



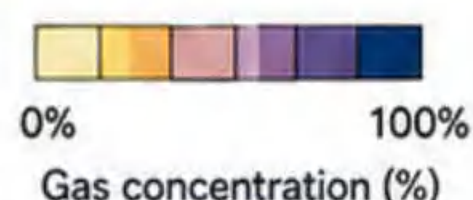
3 Allow the gas to pass through the tube.



4 The chemical inside the tube changes color.

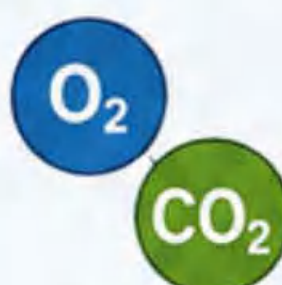


5 The change in color indicates the percentage or concentration of the gas inside the tube.



2 Gas Monitoring Device

A sensor-equipped device that displays the percentage of a gas as numbers on a screen.



Some monitoring devices measure the percentage of oxygen (O_2) and carbon dioxide (CO_2) at the same time.



Such devices are used in hospital intensive-care rooms for patients who suffer from breathing problems.



Caution: Do not touch the broken ends of the detection tubes because they may cause injury.

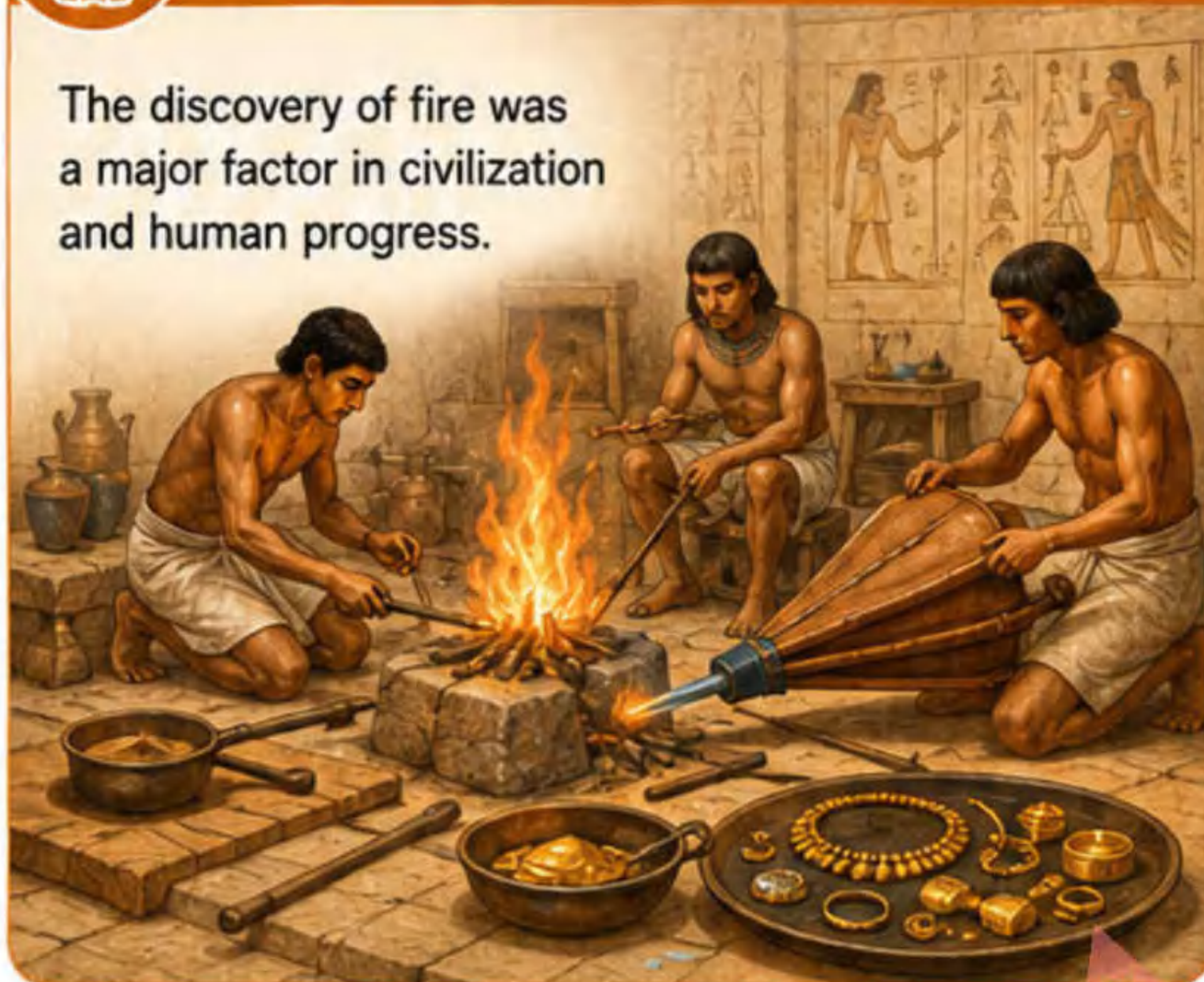


Combustion and the Future of Energy



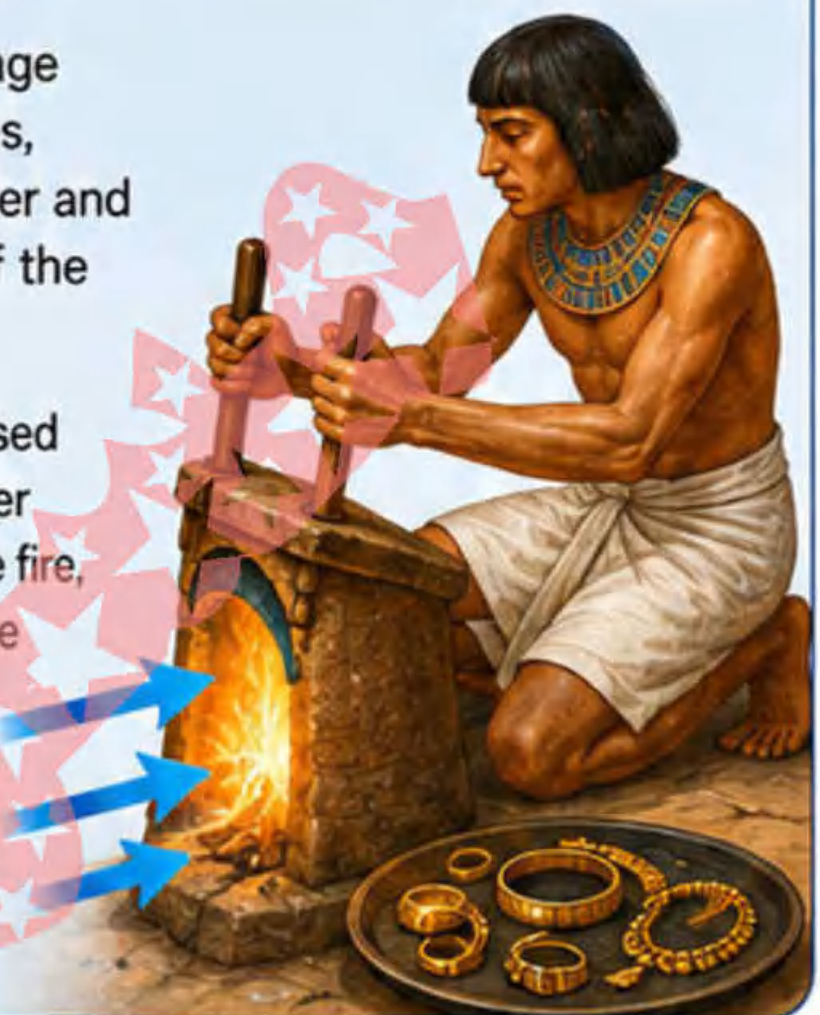
Fire and Ancient Egyptian Civilization

The discovery of fire was a major factor in civilization and human progress.



How did ancient Egyptians use oxygen in combustion?

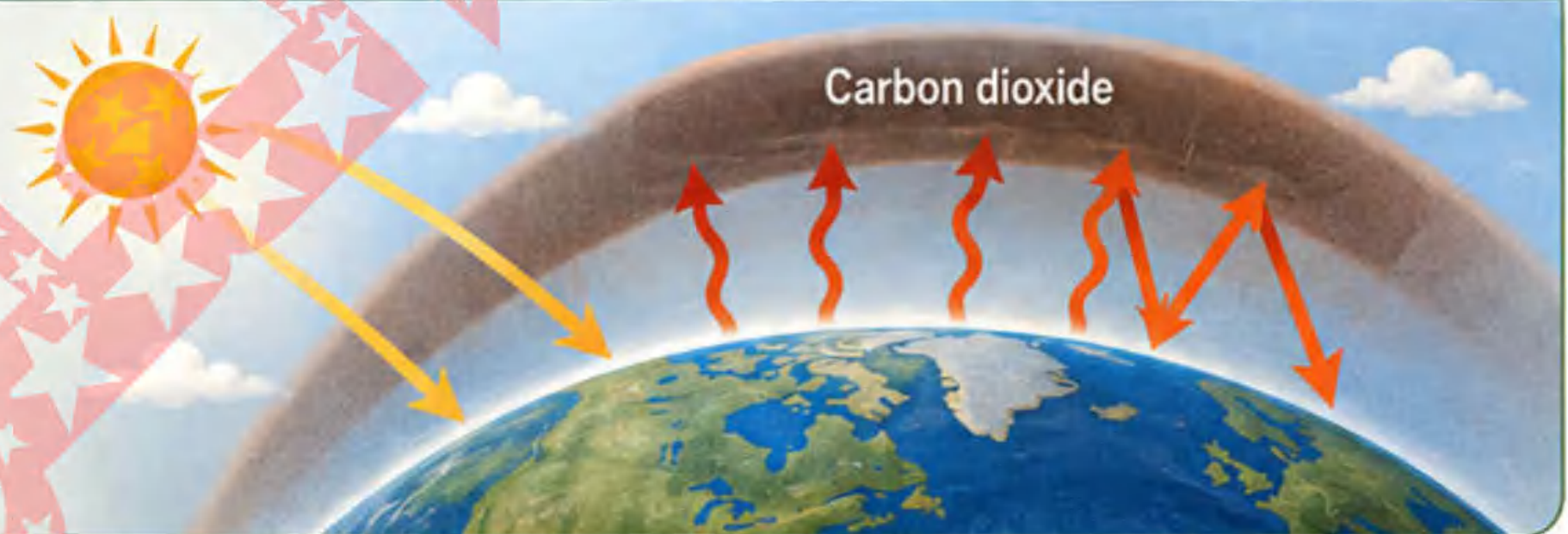
- When the percentage of oxygen increases, materials burn faster and the temperature of the flame rises.
- Ancient Egyptians used bellows to blow larger amounts of air into the fire, which helped raise the fire temperature.
- They used this in smelting gold and making jewelry.



What happens when carbon dioxide increases in air?

- An increase in carbon dioxide in air raises Earth's temperature.

This is called the greenhouse effect.



Renewable Energy

- Instead of burning coal and oil to obtain energy, people can use renewable energy sources such as the Sun and wind.



Benban Solar Power Station

- It is a huge solar-energy station in Benban village, 35 km from Aswan.

Importance of Benban:

- It generates electricity without burning fuel.
- This reduces carbon dioxide emissions.





Chapter 1 Review

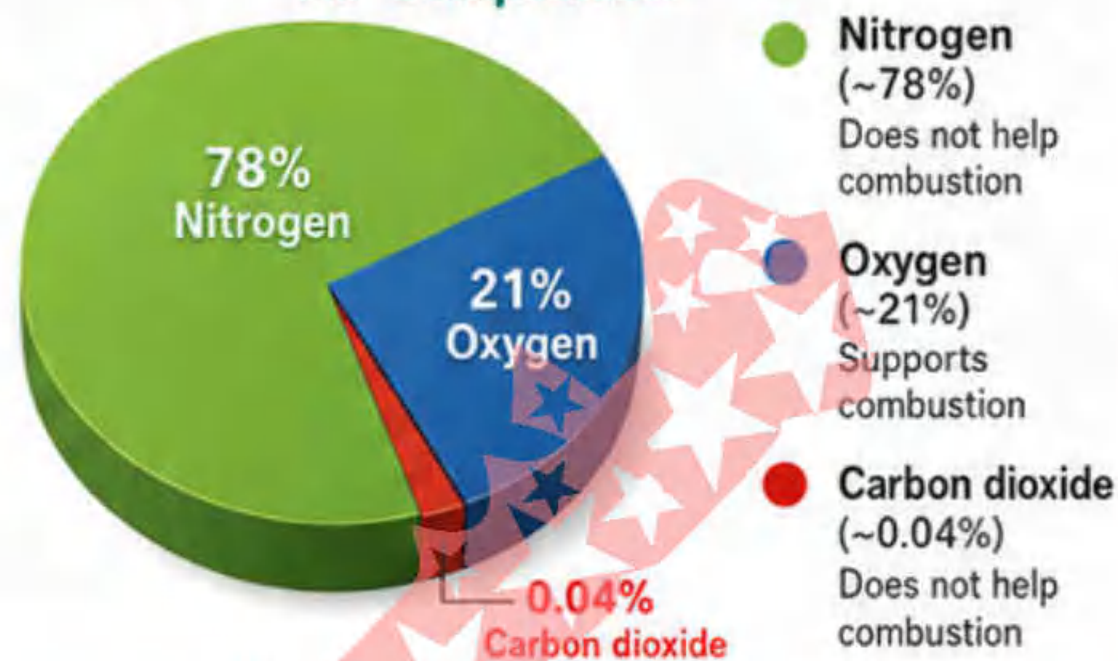
Conditions of Combustion



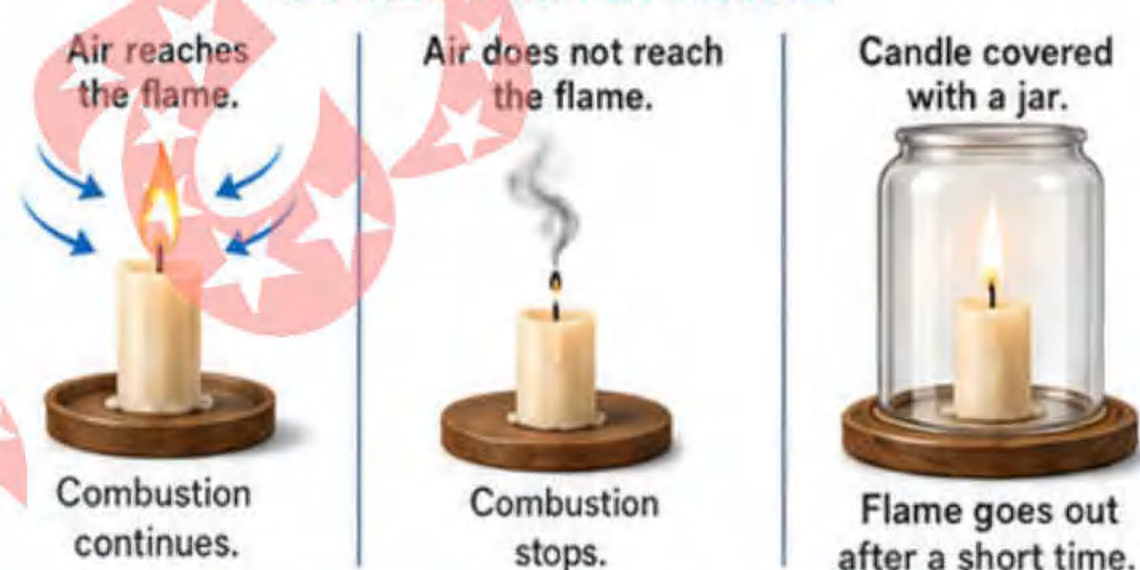
Key Ideas at a Glance

- 1 Air is necessary for combustion to happen and continue.
- 2 When air does not reach the flame, combustion stops.
- 3 Covering a candle with a jar makes it go out after a short time because the air inside the jar is used up.
- 4 Atmospheric air consists mainly of nitrogen, oxygen, and carbon dioxide.
- 5 Oxygen forms about 21% of air and supports combustion.
- 6 Nitrogen forms about 78% of air and does not help combustion.
- 7 Carbon dioxide forms about 0.04% of air and does not help combustion.
- 8 Limewater is used to detect carbon dioxide.
- 9 The percentage of carbon dioxide increases during combustion.
- 10 The percentage of oxygen decreases during combustion.
- 11 Limewater turns cloudy when it reacts with carbon dioxide and forms a milky white liquid.
- 12 Colored gas-detection tubes contain chemicals that react with certain gases and change color depending on gas percentage.
- 13 Gas-monitoring devices can measure oxygen and carbon dioxide at the same time.
- 14 Ancient Egyptians used oxygen-rich burning to melt gold and make jewelry.
- 15 The greenhouse effect happens because increased carbon dioxide raises Earth's temperature.
- 16 Renewable energy from the Sun and wind reduces dependence on combustion.

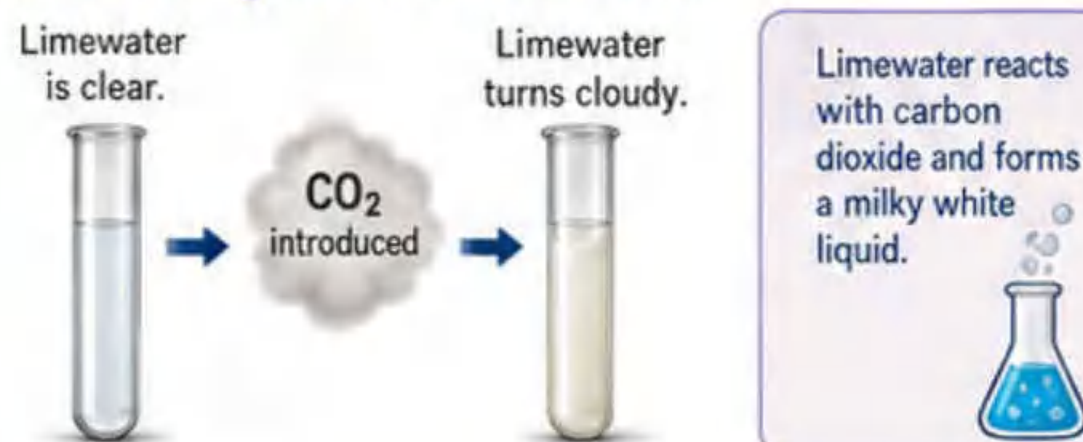
Air Composition



Combustion in Action



Detecting Carbon Dioxide



Gas Detection



Colored gas-detection tubes contain chemicals that react with certain gases and change color depending on gas percentage.

Gas Monitoring



Gas-monitoring devices can measure oxygen and carbon dioxide at the same time.

Real-World Connections



Ancient Egyptians used oxygen-rich burning to melt gold and make jewelry.



The greenhouse effect happens because increased carbon dioxide raises Earth's temperature.



Renewable energy from the Sun and wind reduces dependence on combustion.



Clean energy helps protect our environment for the future.



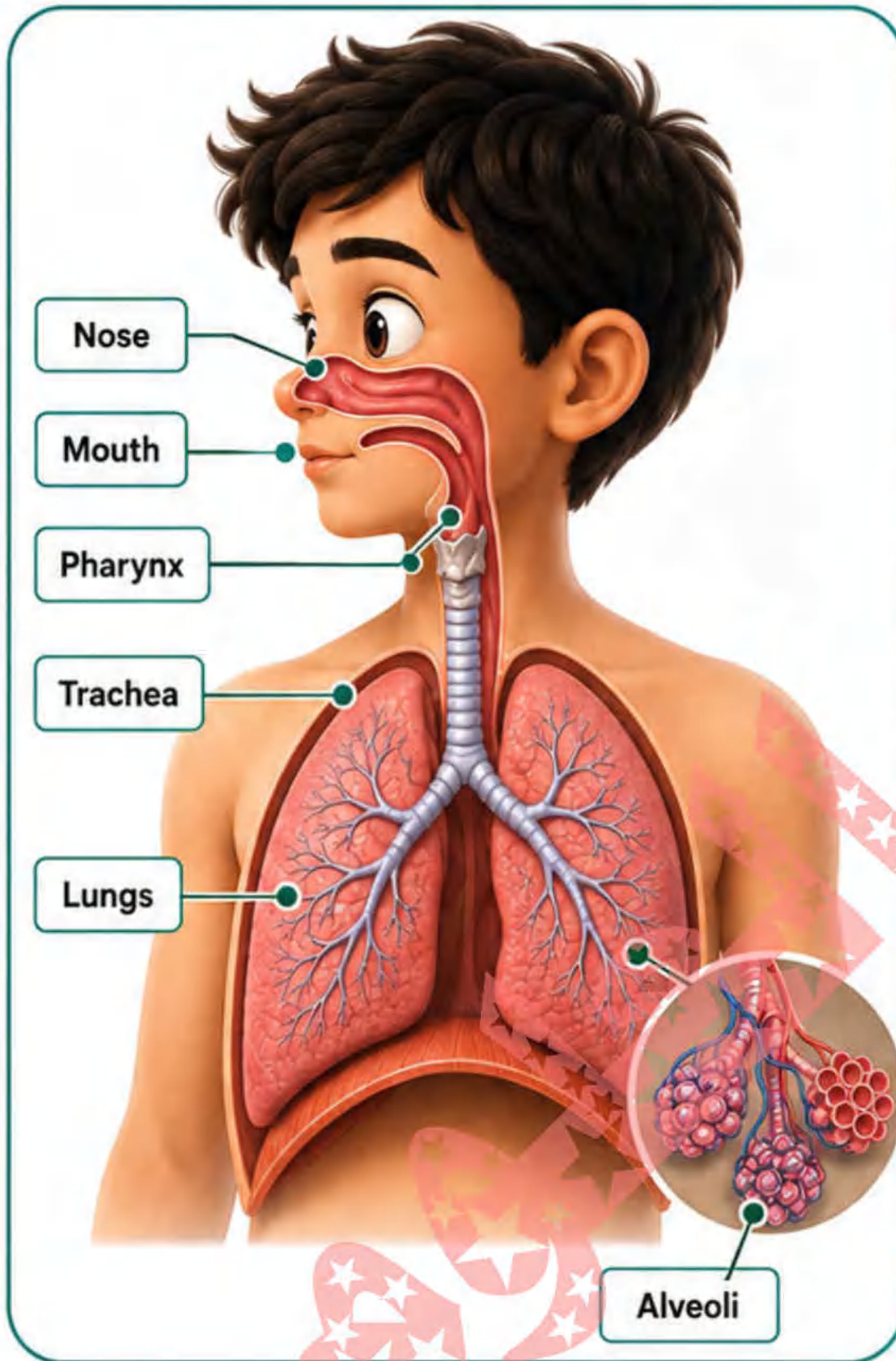
Remember!

Combustion needs oxygen. As a flame burns, oxygen is used up and carbon dioxide increases. Understanding gases helps us stay safe and protect our planet.



Respiration

Chapter Overview



LESSONS IN THIS CHAPTER

2-1

How Does Respiration Occur?

2-2

How Do the Lungs Work?



OUR FOCUS IN THIS CHAPTER



Oxygen enters the body.



Carbon dioxide leaves the body.



Respiration includes inhalation and exhalation.



Gas exchange takes place in the lungs.



Living organisms respire in ways suited to their environments.



Activities can compare inhaled air and exhaled air.



KEY CONCEPT

Respiration is the process in which **oxygen** enters the body and **carbon dioxide** leaves the body.



How Does Respiration Occur?

• Meaning, importance, and the two breathing steps •



KEY CONCEPT

Respiration is the process in which **oxygen** enters the body and **carbon dioxide** leaves the body.



WHY IT MATTERS

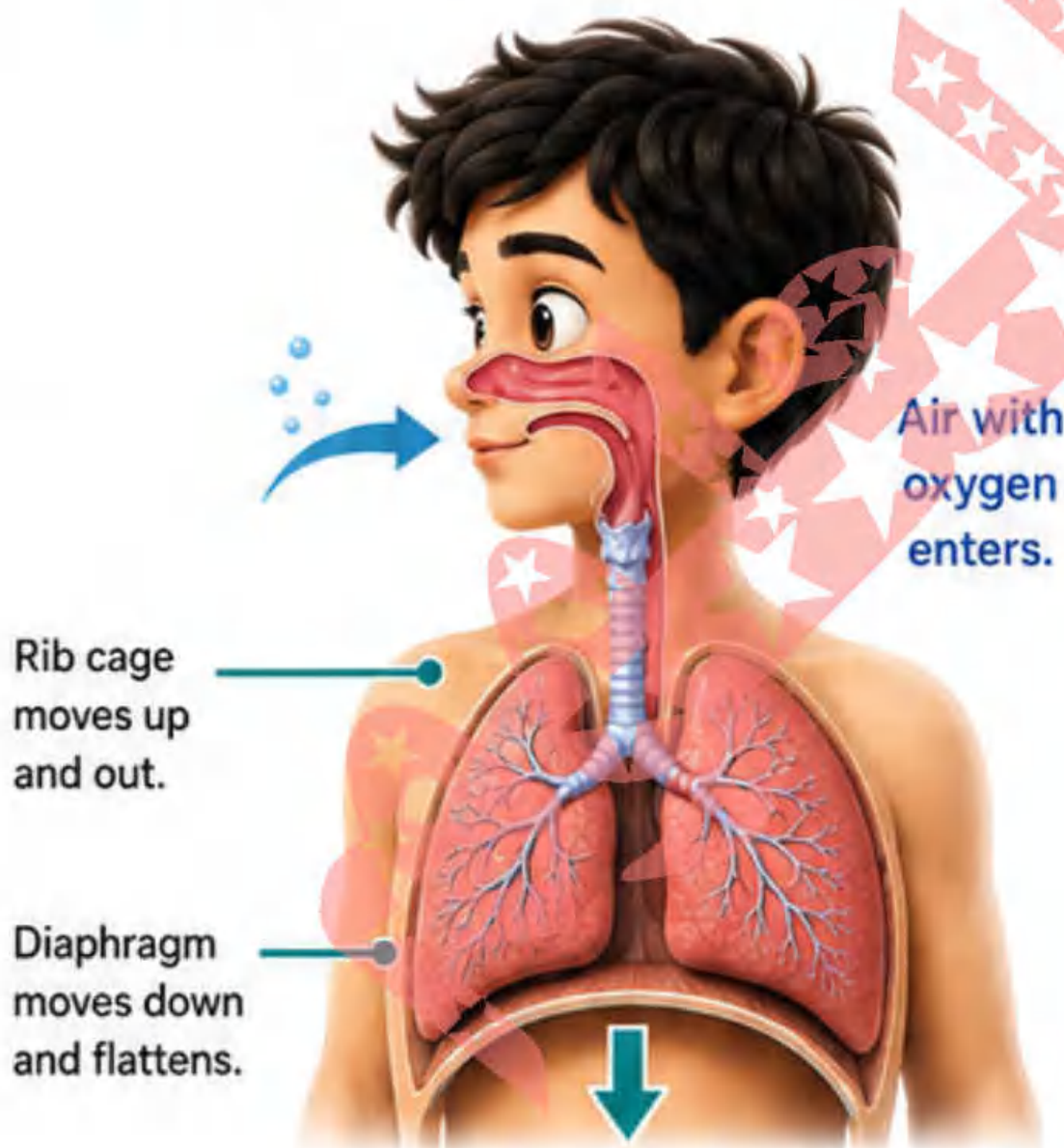
Respiration supplies body cells with the **oxygen** needed to release **energy** from food.

THE TWO BREATHING STEPS

1

INHALATION

Air carrying **oxygen** enters the lungs.

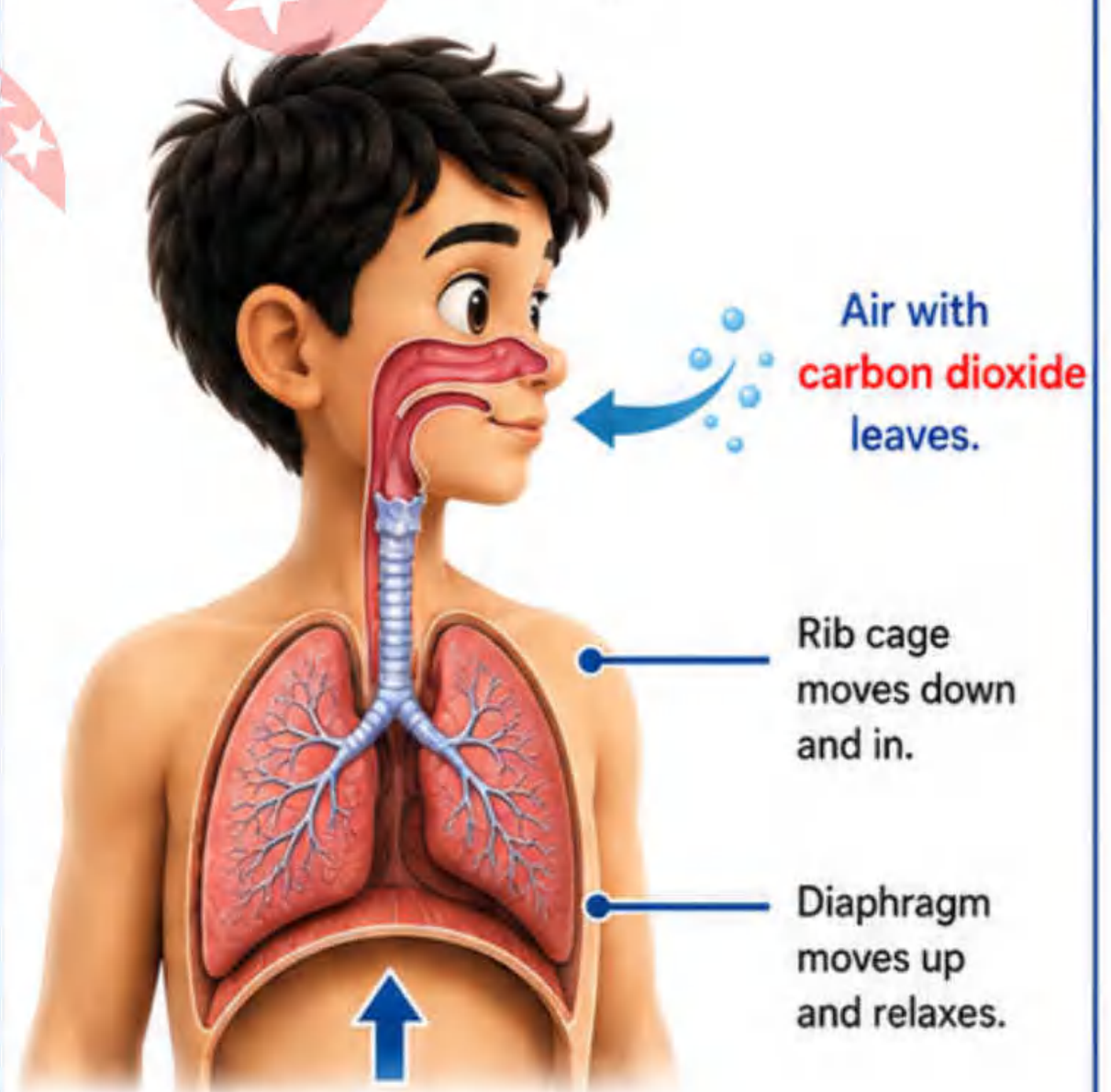


LUNGS EXPAND

2

EXHALATION

Air carrying **carbon dioxide** leaves the body.



LUNGS CONTRACT



NOTE

The air we exhale contains a very small amount of **oxygen** and a large amount of **carbon dioxide** compared with the air we inhale.



How Do the Lungs Work?

The respiratory system and gas exchange

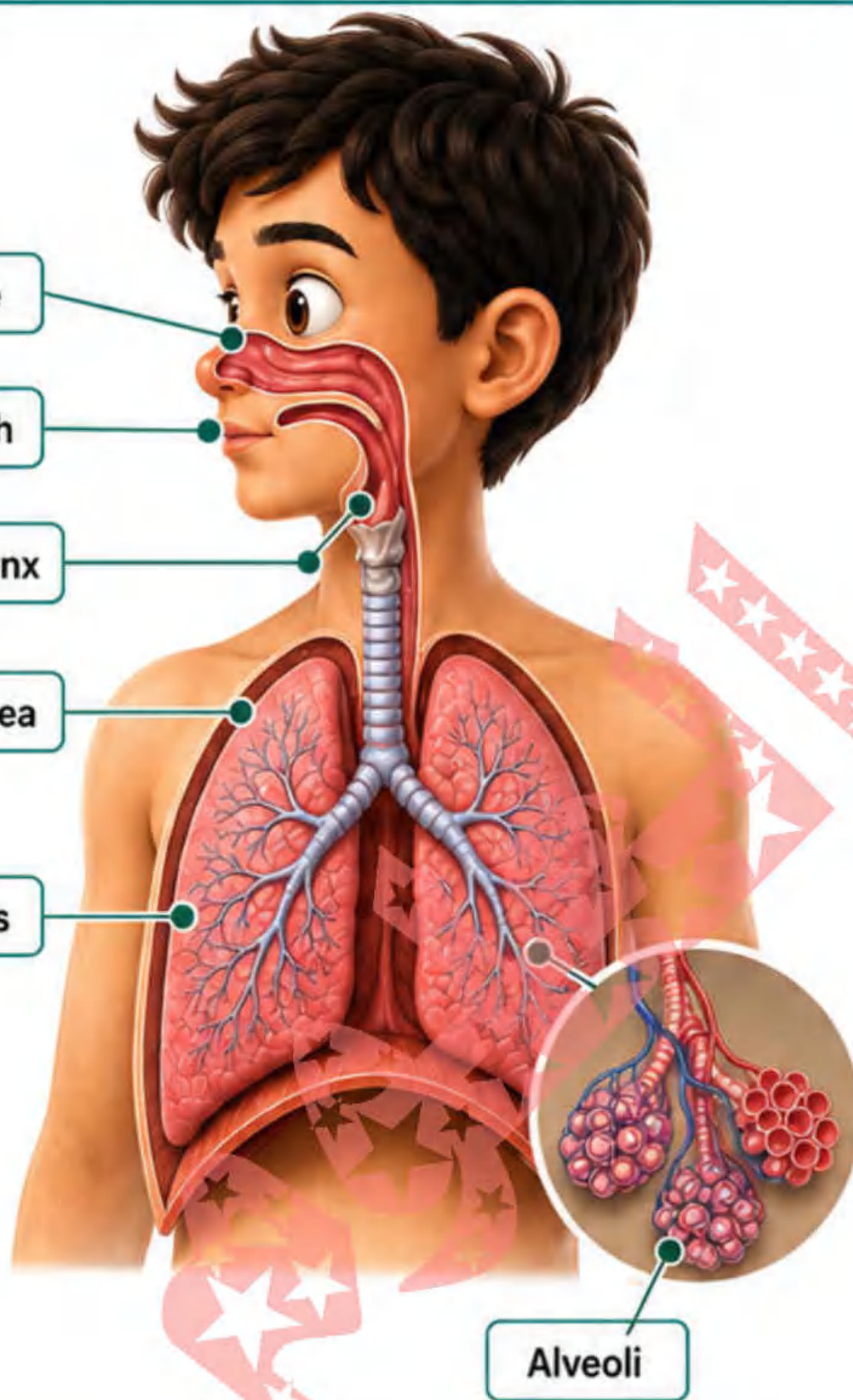


Gas exchange takes place in the alveoli.

Blood vessels carry oxygen to all parts of the body.

Yes

No

☐
☐
☐
☐


RESPIRATORY SYSTEM

The respiratory system is the body system responsible for bringing **oxygen** into the body and removing **carbon dioxide**.



MAIN PARTS OF THE HUMAN RESPIRATORY SYSTEM

- 1- Nose
- 2- Pharynx
- 3- Trachea
- 4- Lungs



Respiration takes place inside the respiratory system.



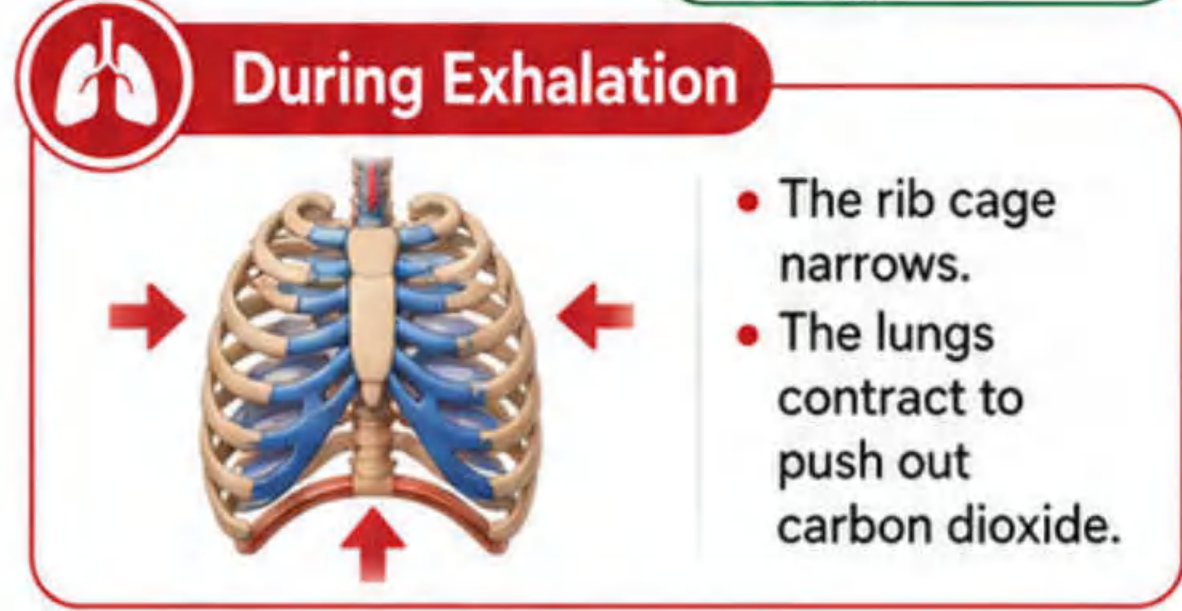
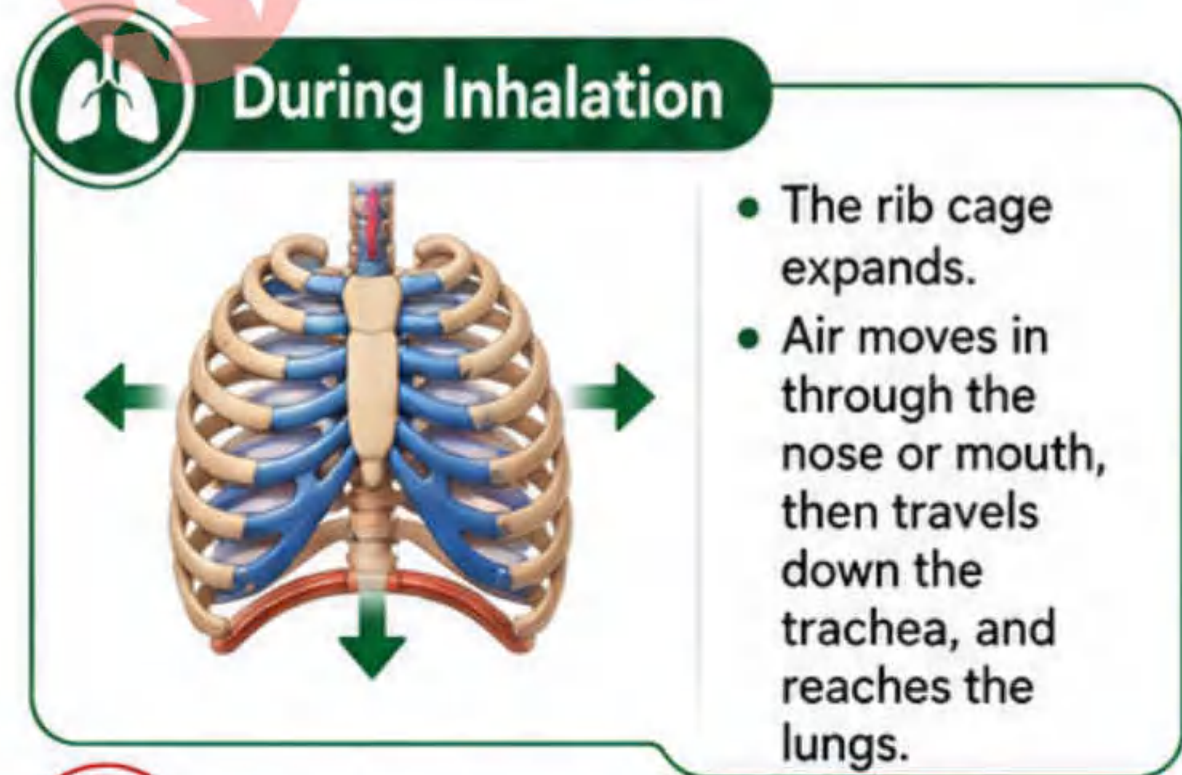
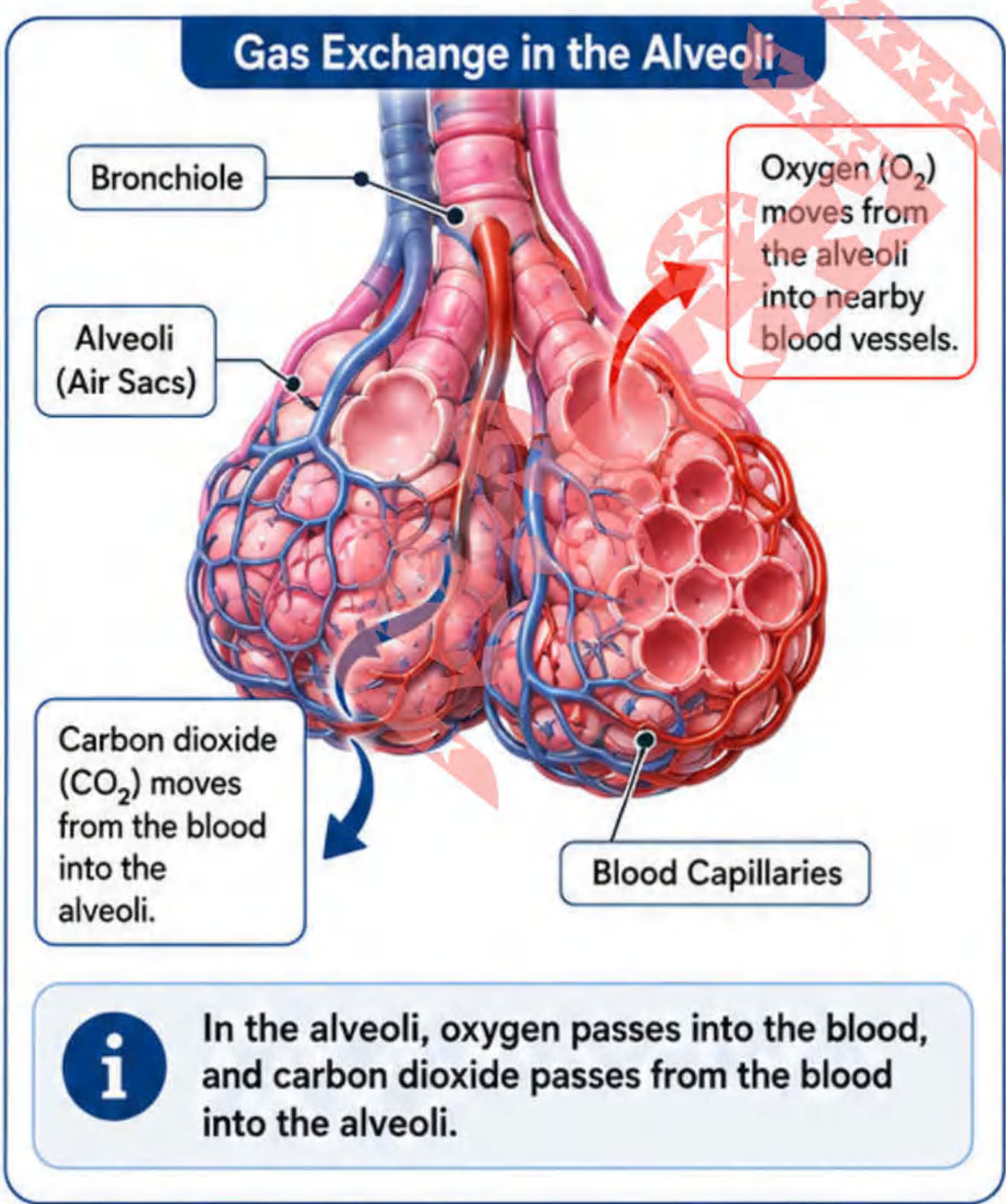
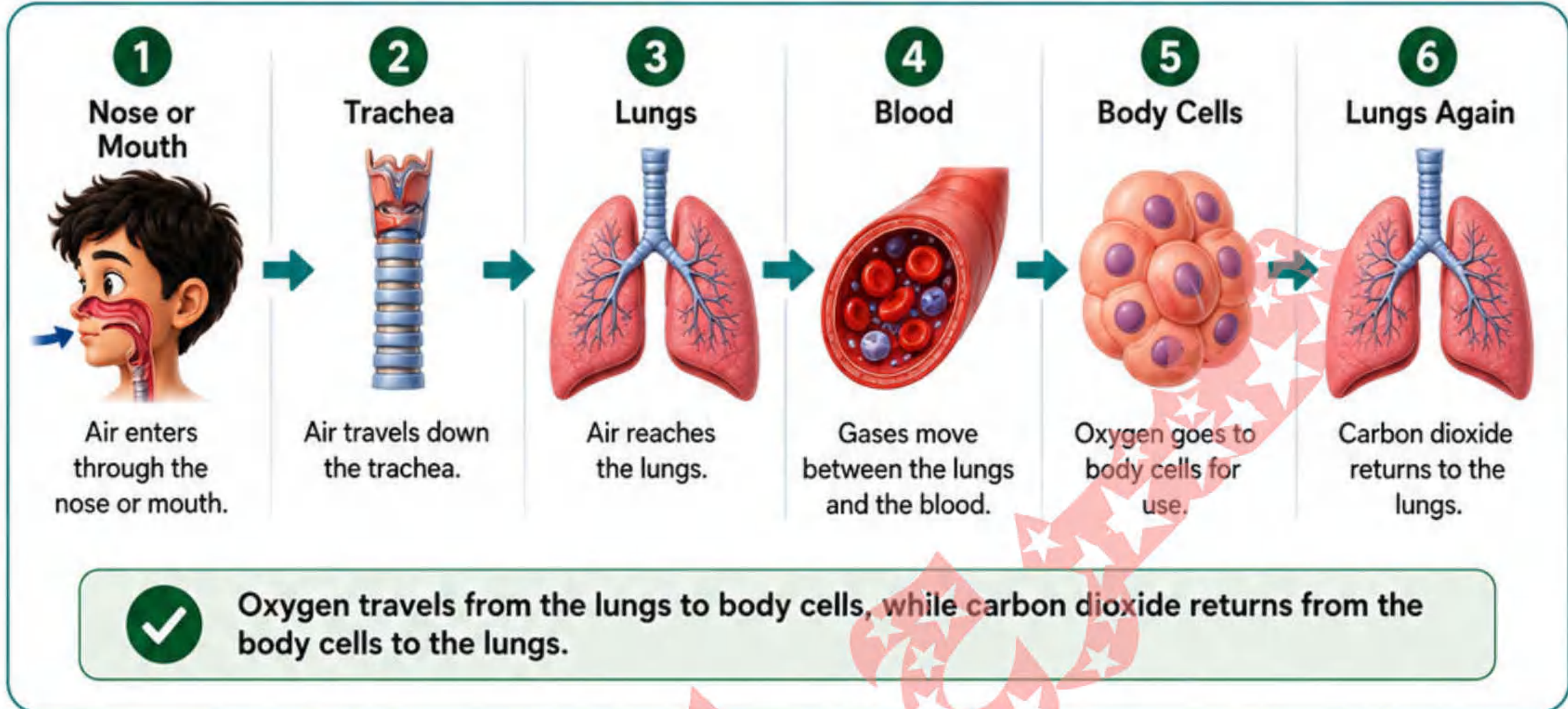
ALVEOLI

Alveoli are tiny air sacs inside the lungs, surrounded by blood vessels, where gas exchange takes place.



Air Path and Gas Exchange

How air moves through the body and how gases are exchanged



♥ The heart pumps oxygen-rich blood to all body cells so they can use oxygen to stay alive and active.



Respiration in Different Environments

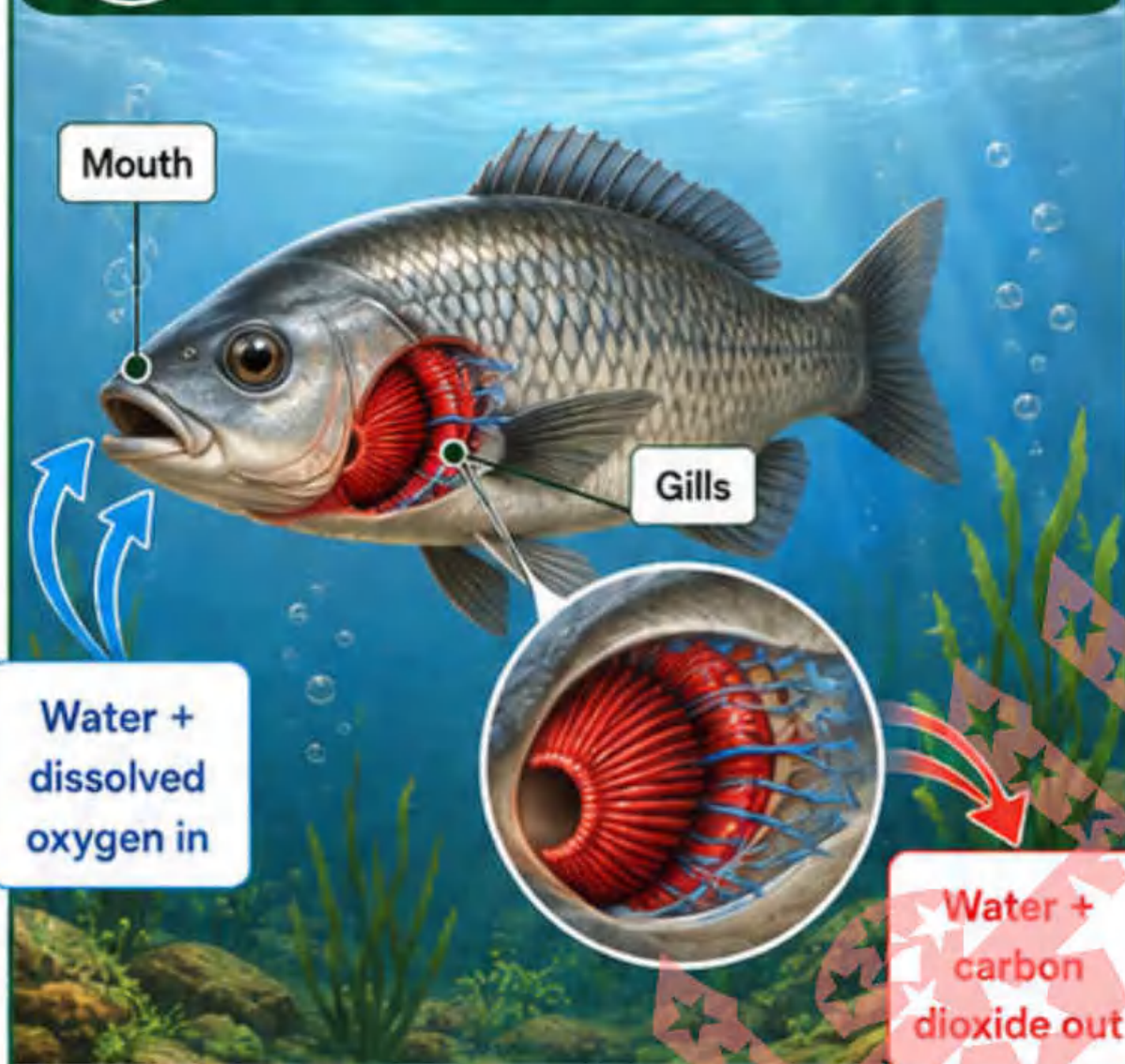
How fish and cats breathe



Animals breathe in different ways that suit the environments in which they live.



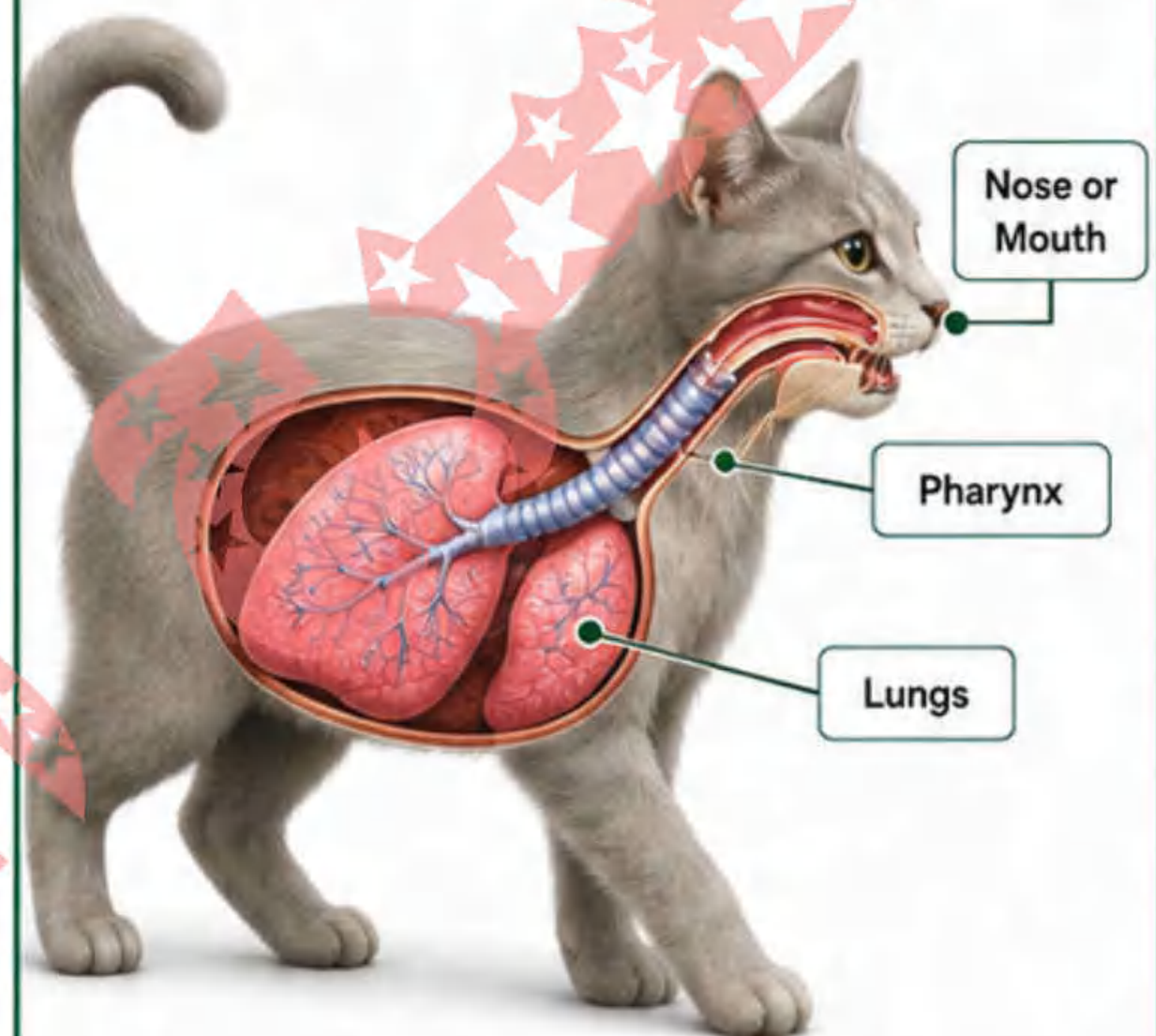
Respiration in Fish



- Water carrying dissolved oxygen enters through the mouth.
- The fish pushes water toward the gills.
- Blood vessels around the gills take oxygen to the rest of the body.
- Carbon dioxide leaves through the gills.



Respiration in Cats



- Air carrying oxygen enters through the nose or mouth.
- Gas exchange takes place in the lungs.
- Air carrying carbon dioxide leaves through the nose or mouth.



QUICK COMPARISON



Fish

breathe in **water** using **gills**.



Cats

breathe in **air** using **lungs**.



Activity 1: Using Limewater

• Comparing exhaled air with room air •



AIM

To compare the amount of **carbon dioxide** in exhaled air and room air.



TOOLS



Two plastic bags



Limewater



Scissors



Safety goggles



STEPS

1

Prepare two plastic bags.



2

Inflate the first bag by exhaling into it.



3

Fill the second bag with room air.



4

Put a small amount of limewater in each bag and shake each bag well.



SETUP

Bag 1:
Exhaled Air



Bag 2:
Room Air



OBSERVATION

Limewater in the first bag becomes cloudier than limewater in the second bag.



Bag 1
(Exhaled Air)

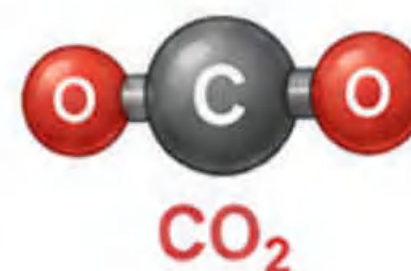


Bag 2
(Room Air)



EXPLANATION

Exhaled air contains a larger amount of **carbon dioxide**, so it reacts more strongly with limewater.



CONCLUSION

Respiration produces a large amount of **carbon dioxide**.



Activity 2: Gas-Detection Tubes

• Comparing oxygen and carbon dioxide in exhaled air and room air •



Repeat the first steps from Activity 1. Make a small hole in each bag, then test oxygen and carbon dioxide using gas-detection tubes.

Procedure

- 1 Make a small hole in each bag.



- 2 Insert an oxygen-detection tube into each bag.



- 3 Insert a carbon-dioxide-detection tube into each bag.



- 4 Compare the readings.



Observed Readings

	Room Air ()	Exhaled Air ()
Carbon Dioxide (CO ₂)	 Lower reading	 Higher reading
Oxygen (O ₂)	 Higher amount	 Lower amount



Conclusions



Respiration produces a large amount of **carbon dioxide**.



Exhaled air contains only a small amount of **oxygen**.



Gas-detection tubes can compare the gases in exhaled air and room air.



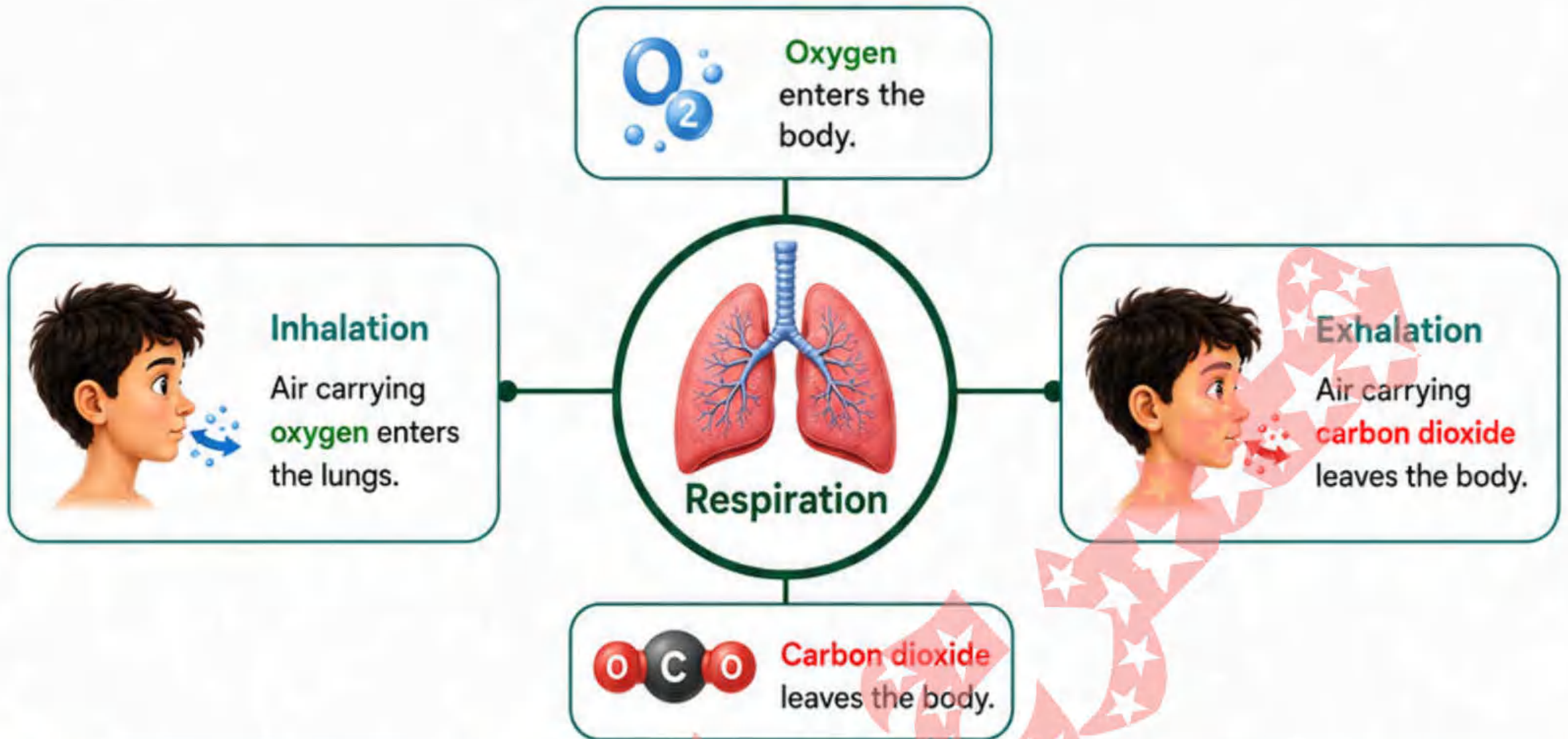
SAFETY FIRST

Wear safety goggles and handle scissors and gas-detection tubes carefully.



Chapter 2 Review

Respiration



KEY TERMS



Respiration — the process in which **oxygen** enters the body and **carbon dioxide** leaves the body.



Inhalation — air carrying **oxygen** enters the lungs.



Exhalation — air carrying **carbon dioxide** leaves the body.



Lung — an organ where gas exchange occurs.



Alveoli — tiny air sacs surrounded by blood vessels.



QUICK REVIEW

- 1 State the meaning of respiration.
- 2 Explain how fish breathe.
- 3 State the role of the heart in oxygen transport.
- 4 State the role of the lungs in gas exchange.
- 5 Compare respiration in fish and cats.
- 6 Name the organ where gas exchange takes place.
- 7 Which gas is present in a large amount in exhaled air?
- 8 How can this gas be detected in the laboratory?



REMEMBER



Gas exchange takes place in the alveoli.



Blood carries **oxygen** to body cells and returns **carbon dioxide** to the lungs.



Exhaled air contains more **carbon dioxide** and less **oxygen** than room air.



Limewater becomes cloudy in the presence of **carbon dioxide**.



THINK LIKE A SCIENTIST!

Observing, measuring, and comparing gases helps us understand how our bodies work and how living things survive.



موقع الدكتور محمد رزق التعليمي



امسح الباركود بالمويل لتثبيت
التطبيق وتحميل كل الملازم مجاناً وبسرعه



حمل التطبيق الآن



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